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Improvement in Looms.

We are seldom called upon to illustrate and describe a more important invention than the one shown in the accompanying engravings. The precise date at which the shuttle in the form which it has held so long was first employed in weaving would be hard to fix. It is mentioned in Job vii., 6. "My days are swifter than the weaver's shuttle." In this passage evident allusion is made to the darting motion of the shuttle when thrown by hand, and it is a most beautiful poetic figure by which the brevity of life is illustrated.

It is certain that the throwing of the shuttle by hand was practiced many centuries ago, and the fact that this method is still retained in the manufacture of many kinds of fine fabrics shows how difficult has been the substitution of any application of power to this motion, which could adequately take the place of the hand, in all kinds of weaving.

The introduction of the picker staff and its adjuncts to actuate the shuttle was an immense stride in the art of weaving. It and the Jacquard attachment constitute perhaps the most remarkable improvements made in the art of weaving up to the date of the present invention.

Notwithstanding the persistence with which the ancient form and method of actuating the shuttle have held their ground, there have always existed serious difficulties, which it was desirable to obviate. Without entering too minutely into details which are perfectly familiar to those acquainted with the art of weaving in all its branches, we will specify a few important defects that the general reader may understand the important advantages the device under consideration is destined to accomplish. First, the distance to which the shuttle can be thrown with certainty, either by the hand, or by the use of the picker staff, is limited, and the difficulty of weaving wide goods is consequently so much greater than that of medium or narrow textures of similar materials, that the cost of wide goods per square yard is considerably more than the narrow. This alone would render a shuttle motion, capable of weaving wide goods as cheaply as narrow, a great desideratum.

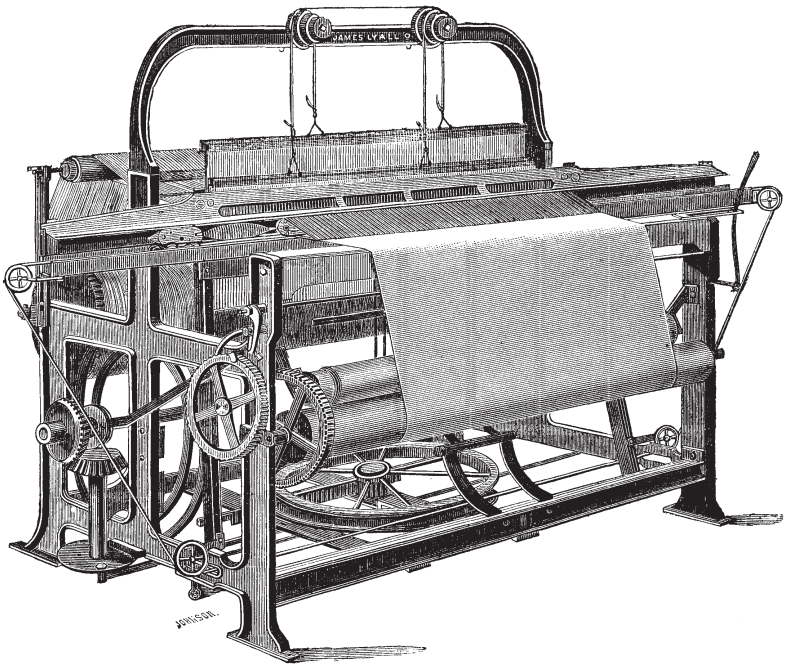
Second, the motion of the shuttle, having no positive relation to the other parts of the loom, the operator has no control over it during the time it is traversing the distance between the shuttle boxes; and the motions of the other parts, if by accident they should take place a little too soon, through the breaking of any of the working parts, or from any other cause, are liable to clash with that of the shuttle. To illustrate this, suppose the shuttle, impelled by too feeble a stroke, to pause in its passage between the sheds of the warp. In a power loom of the ordinary construction the lay would then make its beat, and either drive the shuttle through the warps, making an extensive breakage, or it would spring the dents of the reed. Or both these accidents may occur at the same moment.

In a piece of fine goods the bending of the dents is a disaster which cannot be wholly repaired. They cannot be again perfectly straightened without taking the piece out of the loom, and if the piece is woven to the end with such a defect in the reed, a slack woven streak will appear through the entire remainder of the tissue. In order that the shuttle may traverse with certainty, a regular speed must also be maintained, below which it is impossible to work a power loom with success.

Third, the shuttle reaches the shuttle box after its flight in either direction, and comes to rest before the lay makes its beat. An adjustment so perfect that, at this point, the thread of the weft shall be firmly drawn up against the exterior threads of the warp opposite the shuttle, is necessary to make a perfect selvedge. This perfect adjustment is difficult of attainment, so much so that the character of the selvedge on a piece of linen or silk goods is one of the criterions by which the quality of the article is determined.

To remedy these defects *in toto*, was a reform so radical in its nature, that a motion radically different was necessitated. It is evident from the nature of the case that no absolute connection between the shuttle and any appliance working exterior to the sheds of the warp, can be made capable of lateral motion without breaking the threads. The problem may therefore be enunciated as follows:

Required to produce absolute, positive, and uniform motion in a shuttle, by means of an external appliance moving exteriorly to the sheds of the warp *without absolute and positive connection between the shuttle and the motor through which it receives its motion.* A problem which the majority of mechanics would have pronounced impossible had not its possibility been demonstrated by this invention. But the problem is further complicated by another condition which is omitted in the general enunciation, namely, no lateral motion must be imparted to the threads of the warp.



LYALL'S PATENT POSITIVE MOTION LOOM.

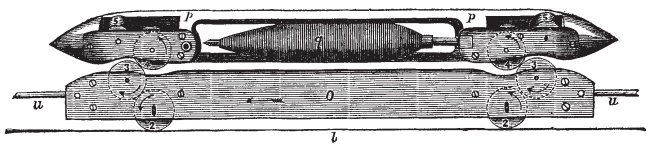


Fig. 2.—Elevation of the Shuttle and Shuttle Carriage.

The ingenious method by which these conditions are fulfilled is shown by Fig. 2, which represents the shuttle resting in its carriage, *o*. Motion is imparted to the carriage and through it to the shuttle by means of a stout cylindrical band, *n*, in a manner to be hereafter described.

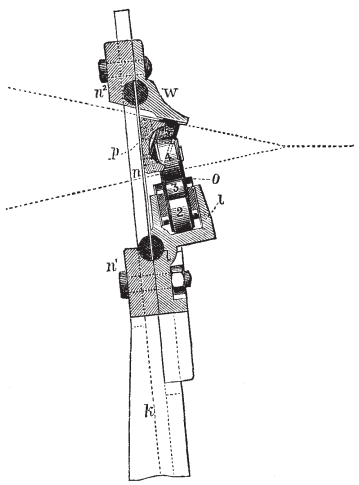


Fig. 3.—Section of Lay and Reed containing Shuttle and Shuttle Carriage.

Let the reader now imagine a sheet of parallel threads stretched between the shuttle, *p*, and its carriage, *o*, and bear in mind that *l* is the upper surface of a race-way running across the lay beneath the warp, upon which the wheels numbered 2 roll. Also notice that the pivots of the wheels, 2, play in slotted bearings, so that their upper surfaces roll on the lower surfaces of the wheels numbered 3. Now suppose the shuttle to be taken off the carriage or driver, *o*, and let this be drawn to the left in the direction of the arrow. It is now evident that the wheels, 2, will revolve in the direction of the arrows drawn upon them, and that their circumferential motion will always be exactly equal to the motion of the carriage, *o*, upon the race-way, *l*, of the lay. But as the slotted bearings of the wheels, 2, allow the weight of the carriage to rest on the pivots of the wheels, 3, and these wheels rest on the tops of the wheels, 2, the wheels, 3, must evidently receive a counter motion in the direction of the arrows marked on them, exactly equal to the motion of the wheels 2, which is likewise equal to the motion of the carriage along the race-way, *l*. If now the sheet of threads be brought into contact with the wheels, 3, it will be seen that while the wheels, 2, are rolling along the race-way, *l*, the wheels, 3, are rolling along the *under* side of the shed of *warp threads*, causing no more lateral motion in those threads than the wheels, 2, cause in the lay, *l*, which is nothing.

We have now seen that the carriage itself produces no tendency to lateral motion in the threads of the warp. Now let us lay on the shuttle, holding it to its place by a beveled rail, a section of which is shown at *w*, Fig. 3; and move the carriage in the same direction as before. The wheels, 2, revolve to the left, and cause wheels, 3, to revolve to the right, and roll along the bottom of the sheet of warp threads. Some of these threads will be successively engaging at each moment between wheels, 3 in the carriage, and wheels, 4, in the shuttle; and, as these threads may be moved in a vertical direction without conflicting with the object we wish to attain, wheels, 4, also commence rotating to the left and thus roll along the top of the sheet of warp threads, at exactly the same speed as wheels, 3, so that each thread of the warp in succession is passed between the lower surfaces of the wheels, 4, and the upper surfaces of the wheels, 3, without being pulled laterally, their only motion being a slight vertical one, owing to the relative positions of the wheels. The wheels, 5, do not engage with the wheels, 4, but roll along the under surface of the beveled rail, *w*, Fig. 3, holding the shuttle down to its work.

The formation of the race-way in which the shuttle carriage rolls, is shown in Fig. 3. The back is the reed, *n*. The beveled rail which holds the shuttle from falling off the carriage in front, is shown at *w*, and another rail, *l*, does the same for the carriage. When the shuttle and carriage are in place they can only be removed by drawing them out at the end of the lay, unless the bevel rail be taken off by unscrewing the bolts which hold it in place. The extreme lightness with which the parts move, is shown by the fact that, in our recent examination, we found we could easily actuate the loom weaving the six yards wide drugget, by a crank screwed on to the main shaft; the labor being scarcely more than that required to turn a grindstone.

Fig. 1 is a perspective view of a power loom with this shuttle movement attached. In this engraving the band, *n*, which draws the carriage, *o*, may be traced passing over grooved pulleys fixed to the ends of the lay, down over other grooved pulleys attached to the lower parts of the swords, and from thence around a horizontal pulley under and a little back of the cloth beam. Motion is imparted to the horizontal pulley, from the main shaft, by means of a pair of beveled gears, driving a short vertical shaft, with crank and pitman at its lower end, actuating a rack and a pinion attached to the shaft of the horizontal pulley.

A reversing motion being thus given to the horizontal pulley, the band, *n*, which draws the shuttle carriage, is alternately wound up on one side, and unwound on the other side, and a reciprocating movement imparted to the shuttle carriage and shuttle. It is obvious now that by putting different sized

pinions upon the shaft of the horizontal pulley, or by speeding up from the rack, any amount of throw may be obtained for the shuttle, so that the width of the piece to be woven, is only limited by other considerations; so far as the shuttle is concerned there would be no difficulty in weaving a piece sixty yards wide, if such a width were required, at precisely the same rate that it travels in narrow goods, and producing a given number of square yards of cloth just as rapidly in one case as the other. It will be also obvious that any precise rate of speed is not essential, when it is understood that the lay is actuated by a cam motion, and that the cam groove is so cut that the lay must remain stationary until the shuttle has passed entirely through between the sheds, and drawn the shoot of the weft perfectly tight. If a loom were stopped with the shuttle midway between the sheds, and then started, the first thing it would do would be to draw the shuttle out of the way. In short, a breakage resulting from failure of any part of the loom to operate, is a contingency so remote, that it may be considered practically to be nothing.

The loom frame, yarn beam, cloth roller, let-off and take-up motions, together with the heddles, and the means for operating them, are of any usual or desired kind and do not require description here. The lay swings upon swords like those of other looms, but as we have stated, is actuated by a cam, instead of a crank motion. As to the relative merits of the two motions for actuating a lay, we are of the decided opinion the cam motion is the better.

We should neither do justice to ourselves nor the interests of our readers, if we failed to state that we have formed our opinions of this improvement, from actual observation of its operation, both on narrow and wide goods. We have seen it weave various textures, from fine dress silks up to woolen drugget six yards in width, in each of which its work was of the most satisfactory kind. No power loom ever before used can be relied upon to make a selvedge equal to it, and, if we mistake not, many lines of goods produced hitherto only by hand weaving will ere long be successfully woven by power on the positive motion loom.

Instead of complicating the loom, this invention has actually simplified it, reducing the number of parts, and introducing no motions or attachments liable to get out of repair. It is to the loom what the link motion is to locomotive engineering, or the compass to navigation. It substitutes certainty for uncertainty and thus lays the foundation for future development in the textile arts hitherto unattainable. Radical in its character, it may be compared to the invention which placed the eye of the sewing-machine needle at the point, and like that invention, it will, in its proper field, be likely to produce results impossible at present to estimate at their true value.

This improvement was patented in the United States, Aug. 11, 1868, by James Lyall, of this city, and has since been patented in the chief European countries, and is the first and only positive shuttle-motion loom. It is now in operation, in various kinds of work, at 35 and 37 Wooster street, New York, the office of the Positive Motion Loom Company, whom address for further information.